

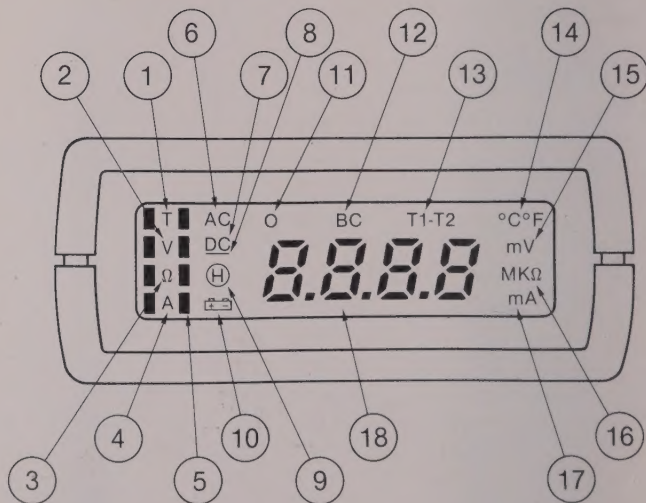
HIGH PERFORMANCE TRUE RMS MULTIMETER/THERMOMETER



OMEGA
ENGINEERING, INC.
An OMEGA Technologies Company

**MODEL
HHM1
Operator's Manual**

LCD DISPLAY



- | | | | |
|---|-------------------------------------|----|------------------------------|
| 1 | Temperature Function Indicator | 10 | Low Battery Indicator |
| 2 | Voltage Function Indicator | 11 | Ohms Zero Indicator |
| 3 | Resistance Function Indicator | 12 | Speech Mode Indicators |
| 4 | Current Function Indicator | 13 | Temperature Mode Indicators |
| 5 | Function Indicator Highlight Bars | 14 | Temperature Units Indicators |
| 6 | AC Measurement Indicator (True RMS) | 15 | Voltage Units Indicator |
| 7 | DC Measurement Indicator | 16 | Resistance Units Indicator |
| 8 | Negative Polarity Indicator | 17 | Current Units Indicator |
| 9 | Display Hold Indicator | 18 | 3 1/4 Digit Display Reading |

CONTROLLED
DOCUMENT

OMEGA
HHM1
RMS MULTIMETER/THERMOMETER

CONTROL # E-3715
DATE: 09/22/94

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HIGH PERFORMANCE TRUE RMS MULTIMETER/THERMOMETER OMEGASAYS® (MODEL HHM1)

OPERATOR'S MANUAL

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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2. Model and Serial numbers.
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M1154/0690

The OMEGASAYS® Test Meter has been developed through the unique application of novel engineering concepts. The unexpected results achieved in creating the OMEGASAYS Test Meter is the subject of US Patent #4,949,274. International Patent applications are pending.

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MULTIMETER/THERMOMETER

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MODEL HHM1 - - - - QUICK SUMMARY

This summary DOES NOT replace the rest of the manual!! IT IS IMPORTANT FOR YOU TO READ THE WHOLE MANUAL.

1. *HOW DO I CONVERT FROM °C TO °F AND VICE VERSA:* press the C/F button on top of the meter.
2. *HOW DO I ZERO OUT THE RESISTANCE DISPLAY:* press the Ω Zero button on top of the meter.
3. *HOW DO I TURN ON OR OFF THE SPEECH FUNCTION:* when toggling from speech to no speech, "B" is displayed (for speech enabled), and then "B" is not displayed (for speech disabled).
4. *WHAT KIND OF THERMOCOUPLE PROBES CAN I USE WITH THE HHM1:* Use only Type K thermocouples.
5. *ON THE DISPLAY, HOW DO I CHANGE FROM "B" TO "C" (that is from speech-on-demand to continuous speech):* you can do it one of three ways: (1) press and hold down the "Hold Display/Speak" button on the top of the meter, (2) press and hold down the button on the (rec custom test probe, or (3) press and hold down the push-button voice acutator on the optional thermocouple handle.

SECTION 1 INTRODUCTION

1.1 DESCRIPTION

The OMEGA[®] Model HHM1 (OMEGASAYS[®]) is a compact, high performance digital multimeter/thermometer with voice annunciation. This handheld meter measures voltage, resistance, current and temperature. Unique to the HHM1 is a remote controlled voice synthesizer which provides verbal measurement data to the user. This speech function allows the user to concentrate on the circuit or environment under test, and receive measurement information without having to look at the meter's display. The HHM1 is supplied with a standard English male voice module. German, and Japanese languages are available. Other languages are available as optional accessories. Refer to Section 6.

1.2 FEATURES OF THE HHM1

The HHM1 features include:

- ✓ Easy-to-read 3-3/4 digit, 4000 count liquid crystal display with annunciators for all measurement functions and modes.
- ✓ 0.25% basic DC accuracy
- ✓ Dual Type-K subminiature thermocouple inputs for temperature measurements
- ✓ All standard DMM measurement functions including AC and DC voltage, AC and DC current, and resistance
- ✓ User replaceable speech modules for multi-lingual applications
- ✓ Leading zero suppression

- ✓ Automatic polarity
- ✓ Overrange indication
- ✓ Autoranging voltage and resistance functions
- ✓ True RMS voltage and current measurement for signals between 50 Hz and 20k Hz
- ✓ Digital ohms zero feature to compensate for the test lead resistance in the lowest resistance range
- ✓ Remote controlled voice annunciator with three user selectable speech modes: speech on command, continuous speech, and speech off
- ✓ Audible soft key recognition in all speech modes
- ✓ Tilting stand integral with case

SECTION 2 OPERATING INSTRUCTIONS

2.1 UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department at 1-800-622-2378.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material in event reshipment is necessary.

Confirm that the following items are in the box:

QTY	DESCRIPTION
1	HHM1 digital multimeter/thermometer with English male voice module and with two fuses installed
1	Set of custom test probes (one red, one black)
2	Beaded wire Type-K thermocouple probes
1	TAS transition adaptor
1	Earphone with cord
1	120V/60 Hz AC Adaptor
1	9 volt battery
1	Carrying case
1	Operator's manual

2.2 PARTS OF THE HHM1 MULTIMETER/THERMOMETER

Before using the HHM1, it is essential for the user to become acquainted with the different parts of the meter. Figure 2-1 shows the most important parts of the meter. Each of the major parts of the meter is discussed in sections denoted by "()".

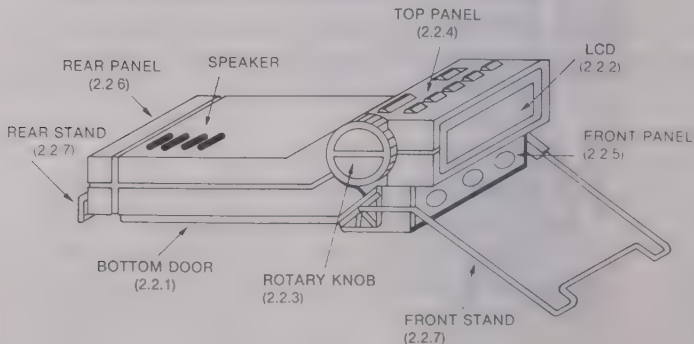


Figure 2-1. HHM1 Meter

2.2.1 BOTTOM DOOR, BATTERY, FUSES AND SPEECH MODULE

The bottom door of the meter provides the user access to the battery compartment, fuses, and speech module. Refer to Figure 2-2. In addition, the door has a label containing important operating instructions and safety precautions.

WARNING

THE HIM1 SHOULD NEVER BE OPERATED UNLESS THE BOTTOM DOOR IS SECURELY LATCHED IN PLACE. TO AVOID ELECTRICAL SHOCK, ALWAYS TURN OFF THE INSTRUMENT AND REMOVE THE TEST LEADS BEFORE REPLACING THE BATTERY, FUSES OR SPEECH MODULE.

To remove the bottom door, turn the meter over and slide the door to the rear of the meter, making use of the finger recess provided (refer to Figure 2-3). The user can now access the battery, fuses, and speech module. To re-install the bottom door, place the door into the track on the bottom case and slide it forward until the door latch engages.

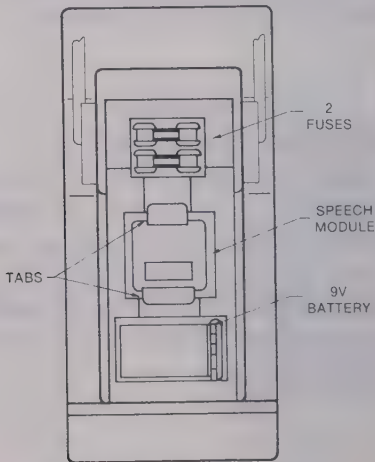
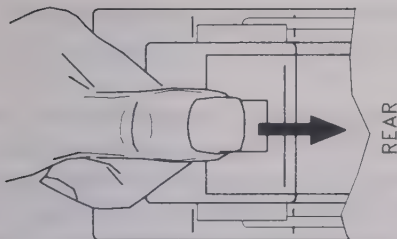
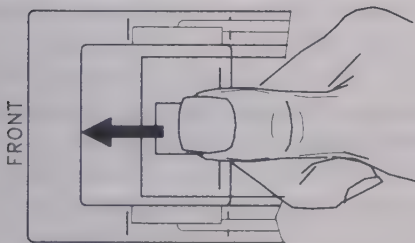


Figure 2-2. Bottom of IHM1



TO OPEN

Figure 2-3a.
How to Open Door



TO CLOSE

Figure 2-3b.
How to Close Door

2.2.1.1 BATTERY INSTALLATION OR REPLACEMENT

The HHM1 is designed to use a single 9V battery. The low battery indicator on the LCD appears when it is time to replace the battery. When the speech function is used often, the battery life is drastically reduced (by a factor of 5 in the continuous speech mode). For this reason, the HHM1 is supplied with an AC adaptor for use with standard 120V/60 Hz power.

To install or replace the battery, go through the following steps.

1. Turn off the HHM1.
2. Remove the test leads from any external connections and from the HHM1 input terminals.
3. Remove the bottom door.
4. Remove the battery from the compartment and carefully disconnect it from the battery clip.

5. Attach a new battery to the battery clip and place the battery back into its recess in the case.
6. Replace the bottom door.

2.2.1.2 FUSE INSTALLATION OR REPLACEMENT

The HHM1 has two separate current inputs (a 400mA range and a 4A range) and each input has its own fuse to protect it from an input overload. These two fuses are different, and care should be taken when replacing either fuse to make sure a correctly rated fuse is installed in each fuse holder. The fuse closest to the front of the meter is a 400mA/250V fast acting fuse. The fuse closest to the rear of the meter is a 4A/250V fast acting fuse. Labels on the bottom door and on the printed circuit board beneath each fuse remind the user of the correct fuse ratings. Both fuses are of the 5 x 20 mm type.

To install or replace the fuses, go through the following steps:

1. Turn off the HHM1.

2. Remove the test leads from any external connections and from the HHM1 input terminals.
3. Remove the bottom door.
4. Using a small screwdriver, or a small, narrow plastic tool, carefully pry the fuse out of the fuse clips. Replace the fuse with a new fuse of the correct current/voltage rating.
5. Replace the bottom door.

2.2.1.3 SPEECH MODULE INSTALLATION OR REPLACEMENT

The HHM1 was designed to accommodate interchangeable speech modules. This feature gives the HHM1 the ability to speak in several different languages. The HHM1 is supplied with an English male speech module already installed. Other languages are available and may be ordered. Contact OMEGA Sales for availability. Changing the speech module is fast and easy.

To remove or install a speech module, go through the following steps:

1. Turn off the HHM1. TO PREVENT POSSIBLE DAMAGE TO THE SPEECH MODULE AND TO INSURE PROPER SPEECH OPERATION, THE METER MUST BE TURNED OFF BEFORE A SPEECH MODULE IS EITHER REMOVED FROM OR INSTALLED IN THE METER.
2. Remove the test leads from any external connections and from the HHM1 input terminals.

3. Remove the bottom door.
4. Grasp the speech module using the built-in tabs and carefully remove it from the center of the meter.
5. Carefully insert a new speech module into the meter, making sure the module has completely engaged with the connectors inside the recess. Note that the speech module has been keyed to insure that it will always be placed into the meter in the correct orientation.
6. Replace the bottom door.

2.2.2 THE LIQUID CRYSTAL DISPLAY (LCD)

The HHM1 uses a liquid crystal display to present information to the user. Figure 2-4 shows you what the LCD looks like when you first turn on the HHM1.

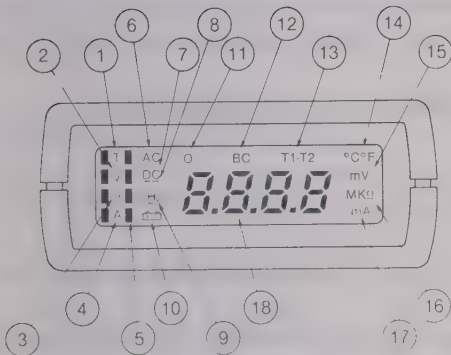


Figure 2-4. LCD Display

In addition to the measurement data displayed on the 3-3/4 digit (4000 count) display, the meter uses a variety of visual annunciators to remind the user which measurement function or mode has been selected.

When the meter is turned on, the entire display is shown for about 3 seconds as a self test and the speech synthesizer will announce which function or mode the meter is in. The individual segments and annunciators are described below:

ITEM	LABEL	DESCRIPTION
1	T	<i>Temperature Function Indicator</i>
2	V	<i>Voltage Function Indicator</i>
3	Ω	<i>Resistance Function Indicator</i>
4	A	<i>Current Function Indicator</i>
5		<i>Function Indicator Highlight Bars</i>
6	AC	<i>AC Measurement Indicator (True RMS)</i>
7	DC	<i>DC Measurement Indicator</i>
8	-	<i>Negative Polarity Indicator</i>

ITEM	LABEL	DESCRIPTION
9		<i>Display Hold Indicator</i>
10		<i>Low Battery Indicator</i>
11	0	<i>Ohms Zero Indicator</i>
12	B C	<i>Speech Mode Indicators</i> B='Button' Mode - speech-on button command C=Continuous Mode - continuous speech No Indicator=speech is turned off or no module is installed
13	T1-T2	<i>Temperature Mode Indicators</i> T1: Single Temperature Mode T2: Single Temperature Mode T1-T2: Differential Temperature Mode

ITEM	LABEL	DESCRIPTION
14	°C °F	<i>Temperature Units Indicator</i> °C Degrees Celsius °F Degrees Fahrenheit
15	mV	<i>Voltage Units Indicator</i> mV Millivolts V Volts
16	MKΩ	<i>Resistance Units Indicator</i> Ω Ohms KΩ Kilo-ohms MΩ Meg-ohms
17	mA	<i>Current Units Indicator</i> mA Milliampères A Amperes
18	8.8.8.8	<i>3-3/4 Digit Display Reading</i>

2.2.3 ROTARY FUNCTION KNOB

The four measurement functions of the HHM1 (temperature, voltage, resistance, and current) are primarily controlled by the rotary function knob on the left side of the meter. This knob has six positions, with the temperature function being the extreme counter-clockwise position and the current function being the extreme clockwise position. Grasp the center bar to rotate the knob.

Figure 2-5 shows the positions of the knob.

ROTARY SWITCH POSITION	FUNCTION
1	Temperature
2	Millivolts
3	Volts
4	Resistance
5	Milliamps
6	Amps

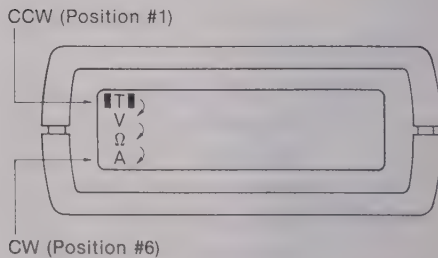
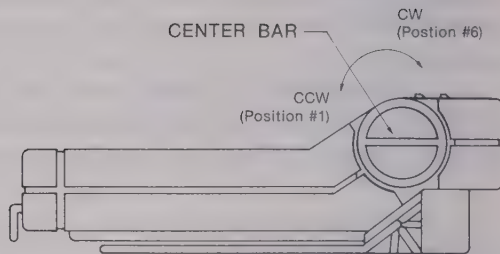


Figure 2-5. Rotary Function Knob Positions

As the switch is rotated through its positions, the function highlight bars on the left side of the LCD will scroll up or down to indicate which function has been selected. Simultaneously, the function selection is audibly announced by the speech synthesizer. Figures 2-6 through 2-11 show the different "screens" that appear in the display.

	T	T1	°F
	V		
	Ω		
	A		

	T	T1	°C
	V		
	Ω		
	A		

Figure 2-6.
Temperature Display

	T	T2	°F	
	V			
	Ω			
	A			

	T	T2	°C	
	V			
	Ω			
	A			

Figure 2-6.
Temperature Display (Cont'd)

	T	T1-T2	°F	
	V			
	Ω			
	A			

	T	T1-T2	°C	
	V			
	Ω			
	A			

Figure 2-6.
Temperature Display (Cont'd)

T		
V	DC	mV
Ω		
A		

T	AC	
V		mV
Ω		
A		

Figure 2-7. Millivolts Display

	T	
	V DC	V
	Ω	
	A	

	T AC	
	V	V
	Ω	
	A	

Figure 2-8. Volts Display

	T	
	V	
	Ω	Ω
	A	

Figure 2-9. Resistance Display

T	
V	DC
Ω	
A	mA

T	AC
V	
Ω	
A	mA

Figure 2-10. Milliamps Display

T	
V	DC
Ω	
A	A

T	AC
V	
Ω	
A	A

Figure 2-11. Amps Display

2.2.4 TOP PANEL

The top panel of the HHM1 contains the main power switch, and six rubber buttons used to select different measurement and speech modes. The buttons select options or sub-functions for each of the rotary switch positions. The buttons have been designed with angled faces. This way the user can read and actuate them from either a top or frontal location. Each of these six buttons is identified in Figure 2-12. A brief description of each button follows.

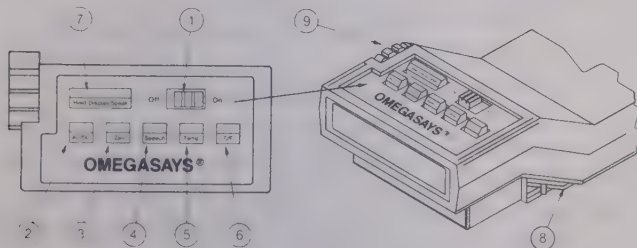


Figure 2-12. Top Panel of Meter

ITEM	LABEL	DESCRIPTION
1	<i>On/Off</i>	<i>Main Power Switch</i> This switch turns the HHM1 on and off.
2	<i>AC/DC</i>	<i>AC/DC button</i> This button allows the user to select AC (True RMS) measurement mode or DC measurement mode. This button is only acknowledged in the voltage and current functions.
3	Ω <i>Zero</i>	<i>Ohms Zero Button</i> This button activates the ohm zero feature. This feature allows the user to touch the test leads together and subtract any test lead resistance which might affect resistance readings in the 400 ohm range. This button is only acknowledged in the 400 ohm range of the resistance function.

ITEM	LABEL	DESCRIPTION
4	<i>Speech</i>	<i>Speech ON/OFF Button</i> This button is used to turn on and off the speech function of the HHM1. This button is acknowledged at all times and allows the user to enable or disable the speech function. If no speech module has been installed, this button is not functional.
5	<i>Temp</i>	<i>Temperature Mode Button</i> This button is used to select one of the three temperature modes: T1, T2 or T1-T2. This button is only acknowledged in the temperature function.
6	<i>C/F</i>	<i>Temperature Mode Button</i> This button is used to choose between Celsius and Fahrenheit temperature modes. This button is only acknowledged in the temperature function.

ITEM	LABEL	DESCRIPTION
7	<i>Hold Display/ Speak</i>	<i>Display hold or Speech Command Button</i> This button has three functions: 1. When the speech mode has been disabled (or no speech module has been installed), this button activates the display hold mode. Pressing the HOLD DISPLAY/SPEAK button freezes the present measurement reading on the display allowing the user to capture readings and look at them. In hold mode, the display hold indicator ($\textcircled{H}$) appears on the LCD. Pressing the HOLD DISPLAY/SPEAK key again releases the meter from hold mode. The meter can also be released from hold mode by changing the rotary switch or by pressing one of the buttons allowed in the present measurement function.

<u>ITEM</u>	<u>LABEL</u>	<u>DESCRIPTION</u>
		2. When the speech function is enabled, this button commands the meter to speak the present measurement reading. Pressing the HOLD DISPLAY/SPEAK button freezes the display while the meter speaks. As soon as speech begins, the HOLD DISPLAY/SPEAK button can be released. 3. During speech output, this button is used to change from 'button' mode (speech on command) to continuous mode (continuous speech) and back again. Normally, the HOLD DISPLAY/SPEAK button is pressed and released to trigger speech output. But, if the button is pressed and held during speech, the meter will change from 'button' mode to continuous mode.

<u>ITEM</u>	<u>LABEL</u>	<u>DESCRIPTION</u>
		This change is indicated by an audible beep, as well as on the display. Likewise, the user can exit continuous mode by again pressing and holding the HOLD DISPLAY/SPEAK button.

Each of the buttons described above is indicated by one of the display indicators described in Section 2.2.2. Each button press is acknowledged by the speech synthesizer (in speech mode) or a single beep (if the speech function has been disabled). This feedback tells you by what change was made.

- | | | |
|---|-----------------------------|---|
| 8 | <i>Front Stand</i> | Used to raise the front of the meter for easier viewing and easier access to the rotary function knob |
| 9 | <i>Rotary Function Knob</i> | Used to select the measurement function (temperature, voltage, resistance or current). For details, refer to Section 2.2.3. |

2.2.5 FRONT PANEL

The front panel of the HHM1 provides the input connections for all the multimeter functions. The four input jacks are shown in Figure 2-13. A brief description of each jack follows.

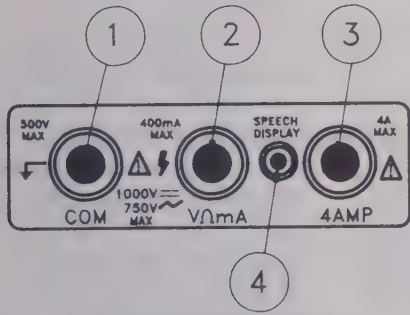


Figure 2-13. Front Panel

ITEM	LABEL	DESCRIPTION
1	COM	Common Jack (terminal) The black or common test lead is connected to this jack for all multimeter functions.

<u>ITEM</u>	<u>LABEL</u>	<u>DESCRIPTION</u>
2	<i>VΩmA</i>	<i>Volts, Ohms, Milliamps Input Jack</i> The red test lead is connected to this jack for the following functions : 1. Millivolts 2. Volts 3. Resistance 4. Milliamps
3	<i>4AMP</i>	<i>Amps Input Terminal</i> The red test lead is connected to this terminal for the amps function only.
4	<i>SPEECH DISPLAY</i>	<i>Voltage/Resistance/Current Probe Speech Input</i> The 2.5 mm phone plug molded into the red test lead is connected to this terminal for all multimeter functions. This input links the push-button on the red test lead to the meter, creating a remote trigger for the display hold and speech functions.

The probe button functions like the HOLD DISPLAY/SPEAK button on the top of the meter. Figure 2-14 shows the custom test probe.

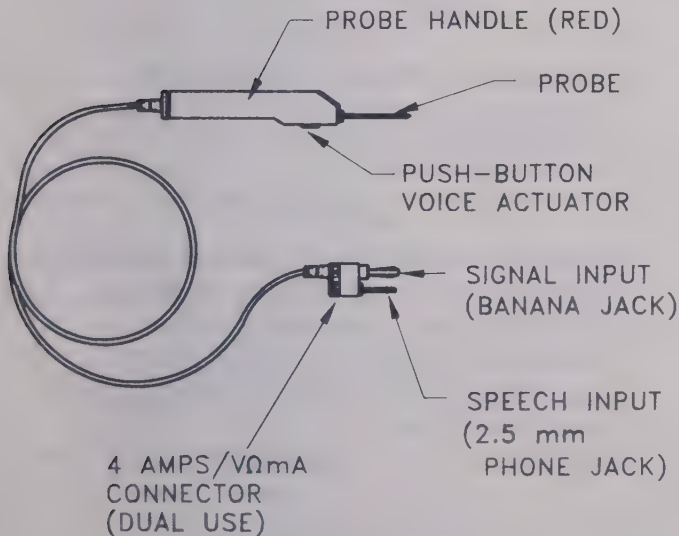


Figure 2-14. Custom Test Probe

The front panel label contains important warnings and maximum input limits information for safe instrument use. Before using the HHM1, it is important to note these maximum input limits for each of the front panel jacks.

CAUTION

EXCEEDING THE MAXIMUM INPUT
OVERLOAD CONDITIONS CAN DAMAGE
YOUR INSTRUMENT.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR
INSTRUMENT DAMAGE, DO NOT
CONNECT THE COMMON INPUT
TERMINAL TO ANY SOURCE MORE
THAN 500 VOLTS DC OR AC RMS ABOVE
EARTH GROUND

FUNCTION	TERMINALS	MAX INPUT LIMIT
AC/DC Millivolts	VΩ mA and COM	250 VAC RMS or DC
AC/DC volts	VΩmA and COM	750VAC RMS or 1000VDC
Resistance	VΩmA and COM	250 VDC or AC RMS
AC/DC Milliamps	VΩmA and COM	400 mA AC RMS or DC
AC/ DC Amps	4 AMP and COM	4A AC RMS or DC

The HHM1 warns the user of input overload conditions by displaying the input overload indicator shown in Figure 2-15.

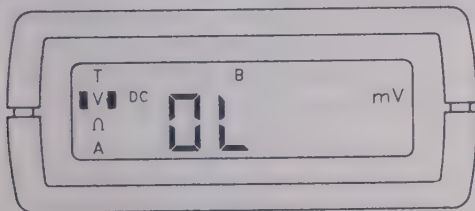


Figure 2-15. Millivolts Overload

The overload indicator does not necessarily mean the meter is being exposed to a damaging input condition. For example, when measuring resistance, an open circuit will cause the OL indicator to appear. Commanding the HHM1 to speak in an overload condition prompts the meter to issue the verbal warnings "OVERRANGE" (voltage or current functions) or "OPEN CIRCUIT" (resistance function).

2.2.6 REAR PANEL

The rear panel of the HHM1 provides the input connections for two Type K thermocouples, as well as several miscellaneous jacks. Each feature of the rear panel is described below and shown in Figure 2-16.

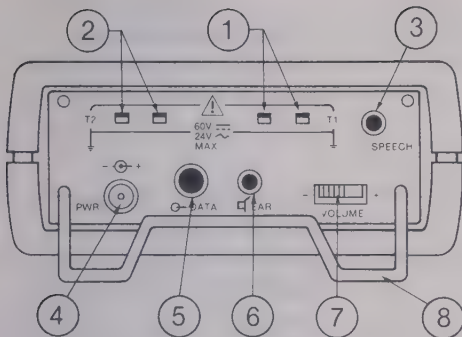


Figure 2-16. Rear Panel

ITEM LABEL

DESCRIPTION

1 T1

T1 Thermocouple Input

This input accepts a single Type-K thermocouple and is keyed to insure correct polarity.

ITEM	LABEL	DESCRIPTION
2	<i>T2</i>	<i>T2 Thermocouple Input</i> This input accepts a single Type-K thermocouple and is keyed to insure correct polarity.
3	<i>SPEECH</i>	<i>Remote Thermocouple Handle Speech Input Jack</i> The 2.5 mm phone plug on the optional button equipped thermocouple handle is connected to this input jack. links the red button on the probe handle to the meter, creating a remote trigger for the display hold and speech functions. The probe button functions like the HOLD DISPLAY/SPEAK button on the top panel. Figure 2-17 shows the thermocouple handle.

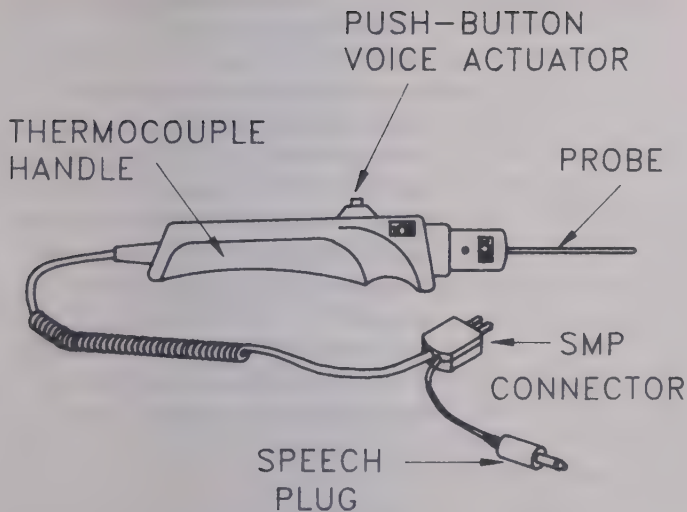


**Figure 2-17. Optional Thermocouple
Handle with Push-button
Voice Actuator**

ITEM	LABEL	DESCRIPTION
4	<i>PWR</i>	<i>AC Power Adaptor Input</i> This socket accepts the 120V/60 Hz AC power adaptor that is supplied with the meter. The adaptor allows the user to conserve battery life during bench top applications or for extended periods of speech use (continuous speech mode). The adaptor will NOT recharge the battery, and only the AC adaptor supplied with the HHM1 should be connected to this input jack. (Note that the battery is disconnected from the internal circuit when using the AC power adaptor).
5	<i>DATA</i>	<i>Data Output Jack</i> RESERVED FOR FUTURE USE

ITEM	LABEL	DESCRIPTION
6	<i>EAR</i>	<i>Earphone Jack</i> The HHM1 is supplied with an earphone for personal listening. The earphone is handy for noisy environments or in places where the user does not wish to disturb other people working nearby. When inserted into the jack, the earphone disables the speaker located on the top of the meter.
7	<i>VOLUME</i>	<i>Volume Switch</i> This three position slide switch adjusts the loudness of the speech. The lowest setting is marked by the minus sign (-) and the highest setting is denoted by the plus sign (+).
8		<i>Rear Stand</i> Used to lift the back of the unit off benchtop for easy access to rear panel connections.

2.2.7 FRONT AND REAR STANDS

The HHM1 is equipped with two stands; one that folds down in the front and one that pulls out in the rear. The five position front stand offers a wide range of operating and viewing angles for field or benchtop use. The rear stand slides out to accommodate and protect any combination of rear panel connections a user may desire. Thermocouple connectors longer than the miniature type supplied with the meter can easily be accommodated without sacrificing front stand adjustment options.

SECTION 3 TAKING MEASUREMENTS WITH THE HHM1

3.1 INTRODUCTION

Once the user has become familiar with the different features and functions of the HHM1, the meter can be put to use. The HHM1 was designed to accommodate two common laboratory tools in one compact, lightweight package.

The HHM1 is designed to be operated as a traditional multimeter or as a thermometer. However, there are practical limitations to its measurement flexibility. Under no circumstances should simultaneous voltage, resistance, current, or temperature measurements be attempted.

The following describes thermocouple notes that should be adhered to:

WARNING

REMOVE THE TEST LEADS AND ANY INPUT SIGNALS FROM THE FRONT PANEL BEFORE MAKING ANY THERMOCOUPLE CONNECTIONS. REMOVE BOTH THERMOCOUPLES BEFORE MAKING ANY FRONT PANEL CONNECTIONS. SEVERE INSTRUMENT DAMAGE MAY OCCUR IF SIMULTANEOUS MEASUREMENTS ARE ATTEMPTED.

NOTE

Temperature Measurement Errors May Occur If Voltages On The Measurement Surfaces Result In Potentials Greater Than 0.5V Between The Two Thermocouples. When Potential Differences Are Anticipated Between The Thermocouples, Electrically Insulated Thermocouples Are Recommended Or Ungrounded Probes Are Recommended.

THERMOCOUPLE CARE

DON'T OVERHEAT THE THERMOCOUPLE

Usually the first thing to fail on a thermocouple assembly is its insulation. Almost always, the wire can withstand more heat than its insulation can. The wire can lose its accuracy if it is allowed to operate for extended periods of time near the high limit of its specifications. This is due to annealing and contamination of the wire's composition.

AVOID CHEMICAL REACTIONS THAT CAN DAMAGE THE THERMOCOUPLES

The presence of various gasses and fluids at particular temperatures can contaminate, etch, or chemically combine with the thermocouple wire. Such conditions can affect its accuracy.

3.2 TEMPERATURE MEASUREMENTS

To make temperature measurements with the HHM1, go through the following steps:

1. Remove any test lead connections from the front panel of the meter.
2. Turn on the HHM1.
3. Select the temperature function using the rotary function knob.

4. If you are using a probe other than the provided Type-K beaded wire probes, or the optional push-button thermocouple handle, you may need to use a TAS transition adaptor. This allows you to convert from standard, round-pin connectors to miniature, flat-pin connectors. Refer to Figure 3-1.

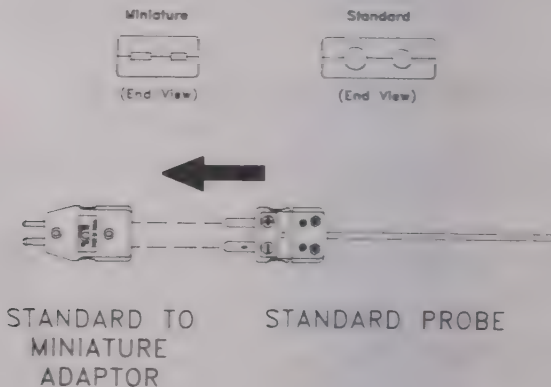


Figure 3-1. TAS Adaptor Application

5. For T1 measurements: Insert a thermocouple into the T1 input jack on the rear panel and press the TEMP button to select the T1 measurement mode.

For T2 measurements: Insert a thermocouple into the T2 input jack on the rear panel and press the TEMP button to select the T2 measurement mode.

For T1-T2 measurements: Insert thermocouples into the T1 and T2 input jacks on the rear panel, and press the TEMP button to select the T1-T2 measurement mode.

6. If you are using a thermocouple handle with a speech input plug, connect the speech plug to the speech jack on the rear panel. Refer to item 3 in Figure 2-16 in Section 2.2.6.
7. Select either degrees C or degrees F temperature display by pressing the C/F button.

WARNING

TO AVOID ELECTRICAL SHOCK, DO NOT USE THIS INSTRUMENT TO MEASURE TEMPERATURE WHEN VOLTAGES AT THE MEASUREMENT SURFACES EXCEED 24VAC OR 60VDC.

TO AVOID DAMAGE OR BURNS, DO NOT MAKE TEMPERATURE MEASUREMENTS IN MICROWAVE OVENS.

An error indicator (open thermocouple indication) will appear on the display if either of the following conditions occur in temperature mode:

1. if no thermocouple is plugged into the selected input.
2. if the thermocouple connected to the selected input is broken or open-circuited.

The open thermocouple indication is shown in Figure 3-2.

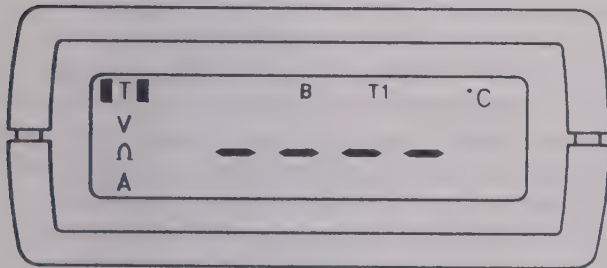


Figure 3-2. Display Showing Open Thermocouple Indication

Commanding the HHM1 to speak in an open thermocouple condition prompts the meter to issue the verbal warning "OPEN CIRCUIT".

3.2.1 To Increase Thermocouple Sensitivity of HHM1

All thermocouples deviate slightly from their theoretical voltage vs temperature characteristics depending on wire gauge and operating temperature. For example, Type-K thermocouples of wire gauge 20 (AWG) have a standard wire error of 1.1 to 2.9 degrees C over their operating range of -270 to 1372 degrees C. The HHM1 is factory calibrated to optimize accuracy over the entire range of thermocouple deviations. Thus, no adjustments are necessary to achieve the rated temperature accuracy of the HHM1. However, two offset adjustments are available to the user. These preset values can be changed in order to trim a given thermocouple for more accurate performance at a given temperature. Likewise, a pair of thermocouples can be adjusted for optimum differential temperature reading in a specific range. The adjustments are made via two unmarked holes in the rear panel. A small screwdriver is required. Refer to Figure 3-3 for hole locations and their respective functions.

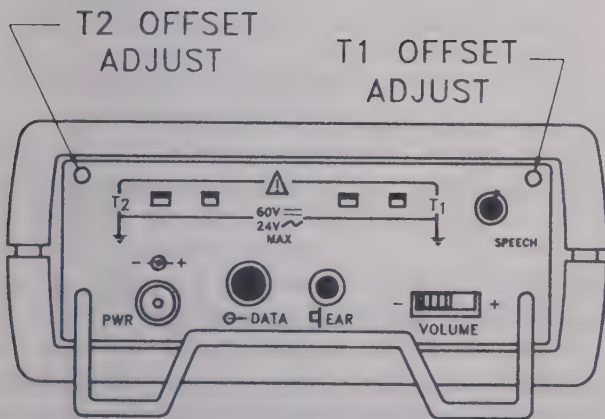


Figure 3-3. Offset Screw Hole Locations

NOTE

When performing either one of the adjustment techniques described below, it is important that only one of the offsets be changed from its factory setting. It is also important that the adjusted offset be marked or recorded. See step 5 in each section below.

3.2.1.1 To Adjust either T1 or T2 offset

To adjust either the T1 or T2 thermocouple inputs, follow these steps:

1. Connect a thermocouple to either the T1 or T2 input, and select either the T1 or T2 temperature mode.
2. Place the thermocouple in an environment which is at or near the temperature you wish to measure, and allow the meter reading to stabilize.
3. Adjust the corresponding offset until the reading on the display matches the known temperature.

4. The meter input and thermocouple have now been paired together, optimizing them for measurements near the set temperature point.
5. Indicate here which thermocouple offset you *adjusted*

T1 or T2

3.2.1.2 To adjust T1-T2 offset

To adjust the T1-T2 mode for optimum differential accuracy, follow these steps:

1. Place thermocouples in both the T1 and T2 inputs and select the T1-T2 measurement mode.
2. Place both thermocouples in an environment at or near the temperature you wish to measure, and allow the meter reading to stabilize.
3. Adjust either one of the offsets until the differential temperature reads 0.0 degrees C.

4. The meter inputs and thermocouples have now been paired together, optimizing them for measurements near the set temperature point.
5. Indicate here which thermocouple offset you *adjusted*

T1 or T2

By keeping one meter offset unchanged, the meter can always be returned to its factory calibration setting.

3.2.1.3 How to Return HHM1 to the Factory Setting

To return the thermometer to its factory setting, go through the following steps:

1. Place the thermocouple in the unmodified temperature input ("untampered" temperature jack - either T1 or T2 jack) and select the unmodified input using the TEMP button. This unmodified thermocouple jack is **not** the one listed in step 5 above.

2. Place the thermocouple in a stable temperature environment, and allow the reading to stabilize. An ice water bath made from crushed ice and distilled water in an insulated container provides a stable, known temperature, as long as the mixture is stirred during measurement.
3. Record the temperature reading and switch the same thermocouple to the modified input (jack).
4. Select the modified input using the TEMP button and adjust the offset until the reading matches that measured in step 3.

3.2.1.4 What to do if both offsets need adjusting

1. Insert thermocouples into both the T1 and T2 inputs and place the thermocouples in an ice water bath.
2. Select the T1 and T2 temperature modes one at a time, and adjust the corresponding offset until the display reads 0.0 degrees C for each.

3.3 VOLTAGE MEASUREMENTS

To make measurements with the HHM1, go through the following steps.

1. Turn on the HHM1.
2. Remove any thermocouple connections from the rear panel of the meter.
3. Select the millivolts or volts functions using the rotary function knob.
4. Connect the black test lead to the COM (common) terminal on the front panel. Connect the red test lead to the $V\Omega mA$ (volts, ohms, milliamps) terminal on the front panel and make sure the speech plug on the probe is plugged in its jack.
5. Select AC or DC measurement mode using the AC/DC button.

6. The HHM1 will autorange over the four voltage ranges (4V, 40V, 400V, 750/1000V) to automatically select the correct measurement range.

CAUTION

Use caution when measuring voltages above 24V RMS or 60VDC. Such voltages pose a shock hazard.

NOTE

The millivolts and volts functions are separate positions on the rotary switch. Make certain the meter is set to the volts position for any input signal greater than 400.0mV AC RMS or DC. If you are uncertain about the magnitude of the voltage you wish to measure, test the voltage first with the volts function. Observe the maximum voltage input limits given in Section 2.2.5.

3.4 RESISTANCE MEASUREMENTS

To make resistance measurements with the HHM1, go through the following steps.

1. Turn on the HHM1.
2. Remove any thermocouple connections from the rear panel of the meter.
3. Select the resistance function using the rotary function knob.
4. Connect the black test lead to the COM (common) terminal on the front panel. Connect the red test lead on the $V\Omega mA$ (volts, ohms, milliamps) terminal on the front panel and make sure the speech plug on the probe is connected to the jack on the front panel.
5. The meter will autorange over the six resistance ranges (400Ω , $4k\Omega$, $40k\Omega$, $400k\Omega$, $4M\Omega$, $40M\Omega$) to select the correct measurement range.

The HHM1 uses a two wire ratiometric technique to make resistance measurements in each of the six ranges. Because of this method, the test lead resistance may affect the accuracy in the 400 ohm range. For this reason, the HHM1 has a digital ohms zeroing feature which allows the user to null out or subtract the test lead resistance (or any desired reference resistance) for more accurate, low resistance measurements. To activate this feature, go through the following steps:

1. Short the test leads together and allow the meter reading to settle to its minimum reading in the 400 ohm range (typically 0.5 ohms or less).
2. While the test probes are shorted, press the OHM ZERO button.
3. The meter reading will change to 0.0 ohms and the ohms zero indicator (0) on the LCD will appear. Simultaneously, the meter will verbally announce, "zero ohms". The test leads must remain shorted together until the ohms zero indicator disappears from the display. This function is shown in Figure 3-4.

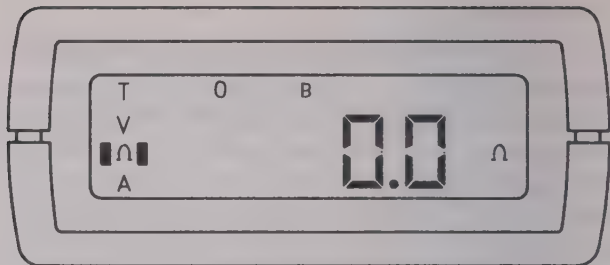


Figure 3-4. Ohms Zero Indicator

3.5 CURRENT MEASUREMENTS

To make current measurements with the HHM1, go through the following steps.

1. Turn on the HHM1.
2. Remove any thermocouple connections from the rear panel of the meter.

3. Select either the milliamps or amps function using the rotary function knob.
4. Connect the black test lead to the COM (common) terminal on the front panel. For milliamps measurements, connect the red test lead to the V Ω mA (volts, ohms, milliamps) terminal on the front panel, and make sure the speech plug on the probe is plugged in its jack. For amps measurements flip the red test lead over and connect it to the 4AMP terminal on the front panel.
5. Select AC or DC measurement mode using the AC/DC button.

WARNING

THE MILLIAMPS AND AMPS FUNCTIONS ARE SEPARATE POSITIONS ON THE ROTARY SWITCH, AND HAVE SEPARATE INPUT JACKS ON THE FRONT PANEL. MAKE CERTAIN THE METER IS SET TO THE AMPS POSITION FOR ANY INPUT SIGNAL GREATER THAN 400.0 mA AC RMS OR DC. IF YOU ARE UNCERTAIN ABOUT THE MAGNITUDE OF THE CURRENT YOU WISH TO MEASURE, TEST THE CURRENT FIRST WITH THE AMPS FUNCTION. OBSERVE THE MAXIMUM CURRENT INPUT LIMITS GIVEN IN SECTION 2.2.5.

SECTION 4 CALIBRATION

NOTE

**THE FOLLOWING
CALIBRATION INSTRUCTIONS
ARE FOR USE BY A QUALIFIED
SERVICE TECHNICIAN ONLY
AND SHOULD BE PERFORMED
IN A METROLOGY LAB.
PRECISION EQUIPMENT IS
NECESSARY FOR ACCURATE
CALIBRATION RESULTS.**

The HHM1 calibration instructions are separated into two parts; calibration of the multimeter functions and adjustment of the temperature function.

The following equipment is required for performing multimeter calibration.

1. HHM1 meter
2. stable DC/AC precision voltage source with $10\mu\text{V}$ resolution
3. leads - banana to banana
4. small insulated screw adjustment tool

4.1 MULTIMETER CALIBRATION

Five calibration holes in the bottom case allow the HHM1 to be calibrated without removing any case screws. To locate these holes, remove the bottom door and refer to Figure 4-1 for the hole locations and numbers.

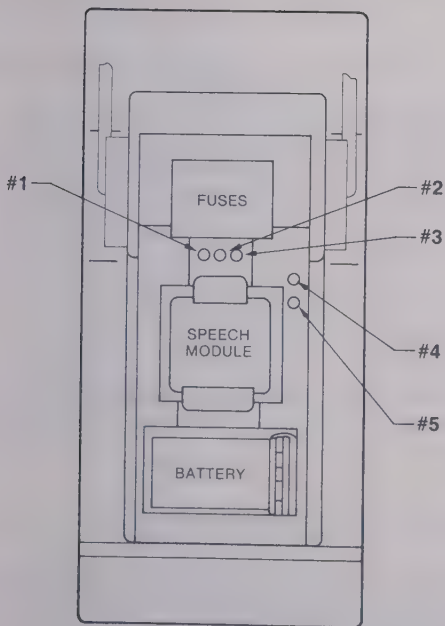


Figure 4-1. Location of Calibration Holes

To calibrate the multimeter functions, go through the following steps:

WARNING
THE CALIBRATION PROCEDURE INVOLVES
MAKING HIGH VOLTAGE ADJUSTMENTS WITH
THE BOTTOM DOOR REMOVED. AN INSULATED
ADJUSTMENT TOOL IS REQUIRED TO ASSURE
SAFETY AND PREVENT EQUIPMENT DAMAGE.

1. Remove all connections to the HHM1 including test probes, thermocouples, earphone, and AC adaptor.
2. Turn the HHM1 on and check the display to see that the battery voltage is good (you won't see the low battery indicator).
3. Remove the bottom door of the HHM1.
4. Connect the common terminal of the voltage source to the COM terminal of the HHM1 and connect the positive terminal of the voltage source to the $V\Omega mA$ terminal of the HHM1.

Multimeter Calibration (Cont'd)

5. Select the DC millivolts function on the HHM1.
6. Output 390.00 mV DC ± 0.05 mV for the voltage supply and adjust the potentiometer at hole #4 until the HHM1 display reads 390.0 mV DC ± 0.1 mV.
7. Select the AC millivolts function on the HHM1.
8. Output 200.00 mV AC ± 0.05 mV at 50 Hz for the voltage supply and adjust the potentiometer at hole #5 until the HHM1 display reads 200.0 mV AC ± 0.1 mV.
9. Select the AC volts function on the HHM1.
10. Output 100.00 VAC ± 0.05 V at 10k Hz for the voltage supply and adjust the potentiometer at hole #1 until the HHM1 display reads 100.0 VAC ± 0.1 V. Note: if your HHM1 serial number is OS0099477 and higher, adjust the potentiometer at hole #3.

Multimeter Calibration (Cont'd)

11. Output 20.000 VAC ± 0.005 V at 10k Hz for the voltage supply and adjust the potentiometer at hole #3 until the HHM1 display reads 20.00 VAC ± 0.01 V. Note: if your HHM1 serial number is OS0099477 and higher, adjust the potentiometer at hole #1.
12. Input 2.0000 VAC ± 0.0005 V at 10k Hz for the voltage supply and adjust the potentiometer at hole #2 until the HHM1 display reads 2.000 VAC ± 0.001 V.
13. Disconnect the voltage source for the HHM1.
14. Replace the bottom door.

Calibration of the multimeter functions is now complete.

4.2 THERMOMETER CALIBRATION

To calibrate the HHM1 temperature inputs (return them to their factory settings), special equipment is required. An ice point reference and high accuracy thermocouple (T/C) reference probes are required. If one of the two temperature inputs has been left at the original factory setting, or if the equipment described is unavailable, the steps described in Section 3.2 can be used to return the T/C inputs close to their original setting. The benefit of using the method described below is that it employs a specially selected, high accuracy thermocouple and an ice point reference that is extremely accurate and stable. To return both offsets to their factory settings, go through the following steps. Refer to Figures 4-2 and 4-3.

Thermometer Calibration (Cont'd)

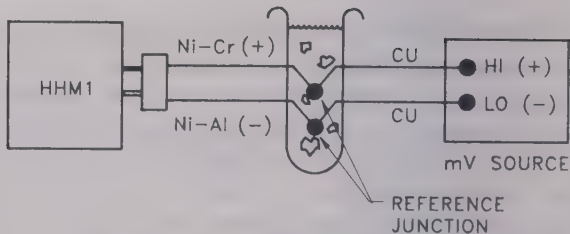


Figure 4-2. Ice Bath Setup

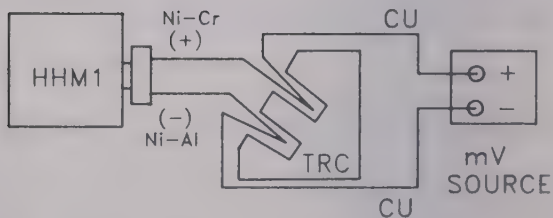


Figure 4-3. TRC-III Setup

Thermometer Calibration (Cont'd)

The following equipment is required for performing thermometer calibration.

1. HHM1 meter
 2. Ice bath or TRC-III
 3. millivolt source
 4. small insulated screw adjustment tool
-
1. Insert a Type K thermocouple reference probe such as the OMEGA TRP-K into an ice point reference chamber (Figure 4-3) such as the OMEGA Model TRC-III or a carefully monitored ice water bath (Figure 4-2).
 2. Connect the copper wires to a precision millivolt source and insert the thermocouple connector into the T1 input of the HHM1.
 3. Select the T1 input by pressing the Temp button.

Thermometer Calibration (Cont'd)

4. Output 0.0 mV from the millivolt source and adjust the T1 offset screw until the meter reads 0.0°C. Refer to Figure 3-3 for the location of the offset adjustment screw.
5. Repeat steps 1 through 4 for the T2 input using the T2 offset adjustment screw.

Adjustment of the thermometer function is now complete.

SECTION 5 SPECIFICATIONS

The HHM1 electrical specifications are based on an operating temperature range of 15 to 35°C and a relative humidity below 80%. The accuracy of the HHM1 is given by

$$\pm(\% \text{ of reading} + \text{number of digits})$$

SPECIFICATIONS (Cont'd)

DC VOLTAGE		
RANGE	RESOLUTION	ACCURACY
400.0mV	0.1mV	0.25% + 2 digits
4.000 V	1 mV	0.25% + 2 digits
40.00 V	10 mV	0.25% + 2 digits
400.0 V	100 mV	0.25% + 2 digits
1000 V	1 V	0.25% + 2 digits

AC VOLTAGE (TRUE RMS)			
RANGE	RES.#	ACCURACY	BANDWIDTH
400.0mV	0.1mV	2.0% + 2 digits	50 Hz - 20k Hz *
4.000 V	1 mV	2.0% + 2 digits	50 Hz - 20k Hz
40.00 V	10 mV	2.0% + 2 digits	50 Hz - 20k Hz
400.0 V	100 mV	2.0% + 2 digits	50 Hz - 10k Hz
750 V	1 V	2.0% + 2 digits	50 Hz - 1k Hz

* bandwidth is 50 Hz - 5k Hz for signals less than 40.0 mV RMS

= Resolution

SPECIFICATIONS (Cont'd)

VOLTAGE INPUT NOTES

DC INPUT IMPEDANCE:	10 M Ω
AC INPUT IMPEDANCE:	10 M Ω shunted by less than 100 pF
INPUT PROTECTION	
400 mV RANGE:	250 V RMS or DC
750/1000 V RANGE:	750 VRMS, 1000V DC
AUTORANGING:	The meter will autorange over all four voltage ranges (4V, 40V, 400V, 750/1000V). The separate 400 mV range is not included in the autoranging feature.

SPECIFICATIONS (Cont'd)

RESISTANCE		
RANGE	RESOLUTION	ACCURACY
400.0 ohms	0.1 ohms	0.25% + 2 digits
4.000k ohms	1 ohm	0.25% + 2 digits
40.00k ohms	10 ohms	0.25% + 2 digits
400.0k ohms	100 ohms	0.25% + 2 digits
4.000M ohms	1k ohms	0.25% + 2 digits
40.00M ohms	10k ohms	0.50% + 2 digits

RESISTANCE NOTES

- INPUT PROTECTION:** 250 VRMS AC or DC
- AUTORANGING:** The meter will autorange over all six resistance ranges
- ZERO ADJUSTMENTS:** The meter has a digital ohms zero feature which allows the user to compensate for test lead resistance in the 400 ohm range.

SPECIFICATIONS (Cont'd)

DC CURRENT		
RANGE	RESOLUTION	ACCURACY
400.0 mA	0.1 mA	0.5% + 2 digits
4.000 A	1 mA	1.0% + 2 digits

AC CURRENT (TRUE RMS)			
RANGE	RESOLUTION	ACCURACY	BANDWIDTH
400.0 mA	0.1 mA	2.0% + 2 digits	50 Hz - 20k Hz *
4.000 A	1 mA	2.0% + 2 digits	50 Hz - 20k Hz **
* Bandwidth is 50 Hz - 5k Hz for signals less than 40.0 mA			
** Bandwidth is 50 Hz - 5k Hz for signals less than 0.400 A			

CURRENT NOTES

RANGES:

The 400 mA and 4A current ranges have separate individually fused inputs.

INPUT PROTECTION

400 mA RANGE:

400 mA/250 V fast acting fuse

4 A RANGE:

4 A/250 V fast acting fuse

SPECIFICATIONS (Cont'd)

RANGE	TEMPERATURE	
	RESOLUTION	ACCURACY
-200°C to -150°C	0.1°C	±12.0°C
-328°F to -238°F	0.2°F	±24.0°F
-150°C to -100°C	0.1°C	±6.0°C
-238°F to -148°F	0.2°F	±12.0°F
-100°C to -50°C	0.1°C	±3.0°C
-148°F to -58°F	0.2°F	±6.0°F
-50°C to 0°C	0.1°C	±1.5°C
-58°F to 32°F	0.2°F	±3.0°F
0°C to 999°C	0.1°C	±1.0°C
32°F to 1830°F	0.2°F	±2.0°F
1000°C to 1372°C	1°C	±1°C
1830°F to 2502°F	1°F	±2°F

SPECIFICATIONS (Cont'd)

TEMPERATURE NOTES

INPUT PROTECTION:	24V RMS or 60 VDC maximum input voltage on any combination of input pins
COMMON MODE VOLTAGE:	The maximum voltage between T1 and T2 during measurement is 0.5V.
MEASUREMENT MODES:	User selectable T1, T2, T1-T2
MEASUREMENT UNITS:	User selectable degrees C or degrees F

SPECIFICATIONS (Cont'd)

POWER SUPPLY:	Standard 9V battery or an OMEGA 115VAC adaptor.
FUSES:	one 400mA/250V fast acting fuse and one 4A/250V fast acting fuse
BATTERY LIFE:	With an alkaline battery, typical battery life is 150 hours. During continuous speech, battery life is 30 hours.

SPECIFICATIONS (Cont'd)

SIZE:	6.7" L x 3.2" W x 2.3" H (170 x 81 x 58 mm) (Refer to Figure 6-1)
WEIGHT:	1 pound 2 oz (0.5 kg) including battery, speech module and fuses.
OPERATING HUMIDITY:	less than 80% RH
OPERATING TEMPERATURE:	32°F to 122°F 0°C to 50°C
STORAGE TEMPERATURE:	14°F to 140°F -10°C to 60°C

SECTION 6 ACCESSORIES

<u>DESCRIPTION</u>	<u>PART NUMBER</u>
Special thermocouple handle with push-button voice actuator	SDX-IHHM1
Custom test leads	HHM1-TL
110VAC power adaptor	HHM1-AC-110
Beaded T/C probe (Type K)	TC-GG-K-24-36-SMP-M
TAS Adaptor	TAS-K-2
Subminiature Quick Disconnect Thermocouple Probe (0.040" dia)	KMQSS-040G-6 (for example)
Standard Quick Disconnect Thermocouple Probe (1/8" dia)	KQSS-18G (for example)

ACCESSORIES (Cont'd)

OPTIONAL ACCESSORIES

<u>DESCRIPTION</u>	<u>PART NUMBER</u>
English Voice Module	HHM1-EG
German Voice Module	HHM1-GR
Japanese Voice Module	HHM1-JP
Voice Modules in other foreign languages	Contact OMEGA Sales for availability
Soldering Iron Temperature Tester Module (Box design) (3.5" L x 1.25" W x 2.2" D) (Refer to Figure 6-2)	STS-1X
Soldering Iron Temperature Tester Module (Round design) (2" diameter) (Refer to Figure 6-3)	STS-2X

ACCESSORIES (Cont'd)

OPTIONAL ACCESSORIES (Cont'd)

<u>DESCRIPTION</u>	<u>PART NUMBER</u>
Soldering Iron Temperature	STS-3X
Tester Module (Piggy-back design) (most popular design) (Refer to Figure 6-4)	
Replacement Sensor Head with Element	STS-H
Replacement Elements, pkg of 3	STS-RE

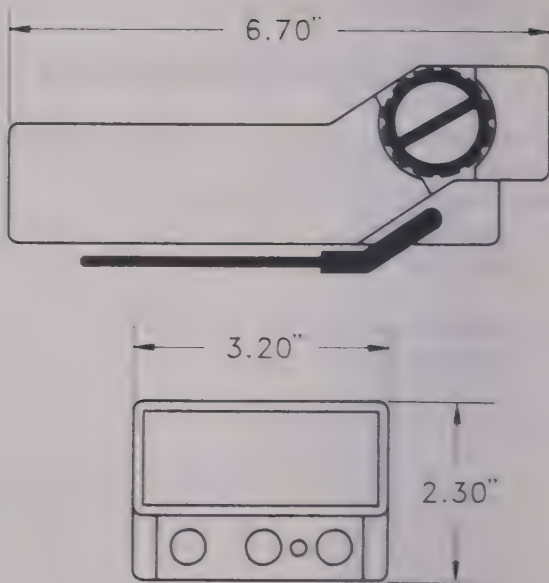


Figure 6-1. Dimensional Diagram of HHM1

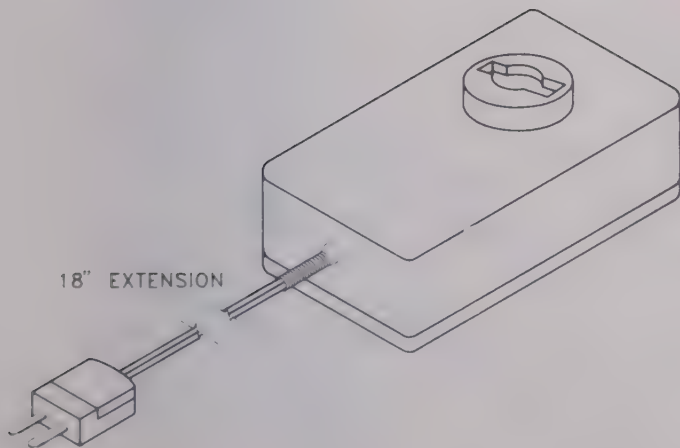


Figure 6-2. STS-1X (Soldering Iron Tester Module)

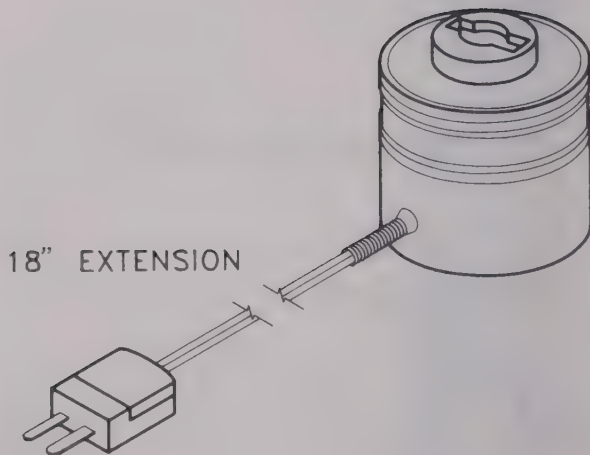


Figure 6-3. STS-2X (Soldering Iron Tester Module)

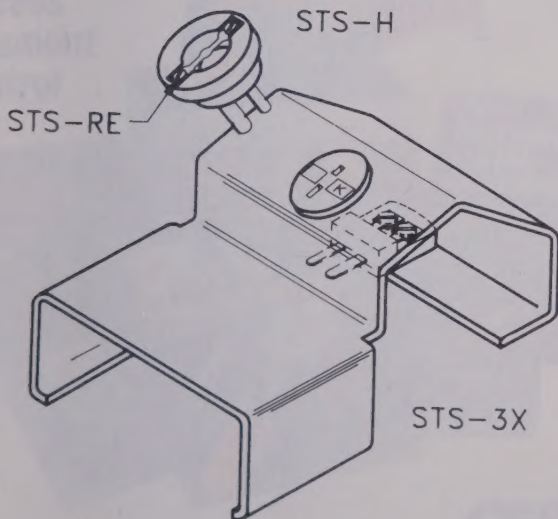
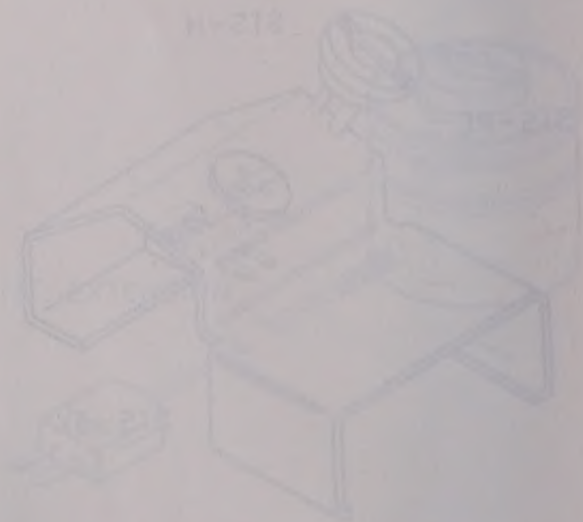


Figure 6-4. STS-3X (Soldering Iron Tester Module)

NOTES



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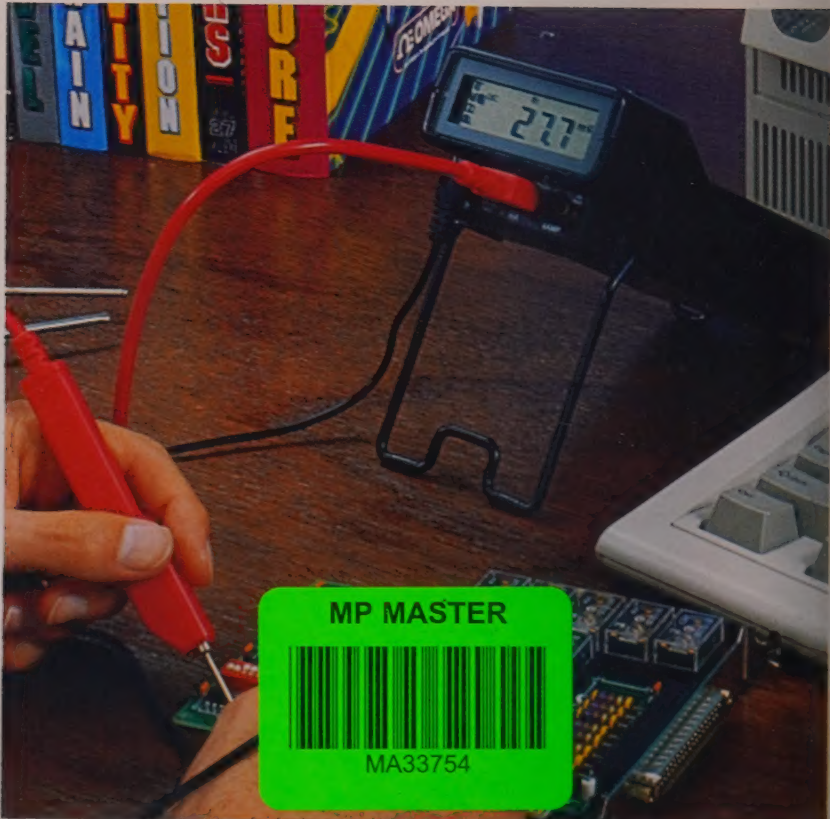
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